constant force from the polymer. Also, if passive layer **50** is relatively compliant but thick, then actuation of portion **56** may still displace the passive layer but the resulting thickness change in passive layer **50** and definition of passive layer surface features may be smoothed out and not have sharp edge definition relative to portion **56**.

[**0089**] The stiffness of the passive layers **50** and **58** may thus be selected depending on a desired absolute displacement. In one embodiment, passive layer **50** comprises a modulus of elasticity less than a modulus of elasticity for electroactive polymer **52**. This reduces the elastic resistance provided by passive layer **50** onto transducer **51** and increases the magnitude and definition of passive layer surface features for a given electrical input. In another embodiment, passive layer **50** comprises a modulus of elasticity less than one tenth than the modulus of elasticity for electroactive polymer **52**.

[**0090**] The thickness of the passive layers **50** and **58** may also be selected depending on a desired absolute displacement. In one embodiment, passive layer **50** comprises a thickness greater than a thickness for electroactive polymer **52**. This increases visual output of surface features produced by actuation of portion **56**. In another embodiment, passive layer **50** comprises a thickness greater than double the thickness for polymer **52**.

[**0091**] Multiple layers the polymer (plus electrodes) and/or the passive layers may also be employed. This also allows actuation of surface features on top of other surface features, e.g., one layer actuates a broad bowl shape and another layer actuates a small bump within the bowl.

[**0092**] In general, passive layer **50** may comprise any material suitable for amplifying the vertical profile and/or visibility of surface features in electroactive polymer **52**. Exemplary passive layer **50** materials include silicone, a soft polymer, a soft elastomer (gel), a soft polymer foam, or a polymer/gel hybrid, for example. The material used in passive layer **50** may be selected for compatibility with a particular electroactive polymer **52**, depending on such parameters as the modulus of elasticity of polymer **52** and the thickness of passive layer **50**. In a specific embodiment, passive layer **50** comprises a compressible foam including a non-linear elastic modulus with strain of the passive layer. In this case, elastic response of passive layer **50** not linear and thus provides varying output (gets thinner or thicker at varying rates) based on the non-linear stress/strain curve.

[**0093**] Deflections, surface features and thickness changes for top and bottom layers **50** and **58** may be asymmetric. As shown in **FIG. 2B**, top layer **50** includes a smaller thickness change than bottom layer **58**. Displacement asymmetry may be achieved via several techniques, such as using different materials with different stiffness for the top and bottom passive layers **50** and **58**, using the same passive layer material but with different thicknesses for the top and bottom layers **50** and **58**, by placing different pre-strains on the top and bottom layer, combinations of the above techniques, etc. Alternatively, using substantially identical materials and similar actuation conditions between top and bottom passive layers **50** and **58** may generate substantially symmetrical displacements for top and bottom passive layers **50** and **58**.

[**0094**] In some cases, larger or more defined surface features **57** may be desirable and methods may be implemented to increase the height of surface features **57**. For example, the thickness of passive layer **50** may be increased, more layers may be added or used, electrode **54** geometry changed, polymer **52** geometry changed, passive layer **50** geometry or material changed, or the distribution of charge across electrodes **54** changed to increase the height of surface features **57**. Alternatively, if desired, surface features **57***a* and **57***b* may be reduced in height by such methods as placing passive layer **50** under strain, by using a surface coating on passive layer **50**, by changing electrode **54** geometry, changing polymer **52** geometry, changing passive layer **50** geometry, or by changing the distribution of charge across electrodes **54**.

4. GEOMETRIC SURFACE FEATURE EXAMPLES

[**0095**] Transducers of the present invention may create wide variability in a set of surface features—both in number and specific shape or geometry for individual features. The surface features may include one or more elevated surface features based on polymer deformation out of the polymer plane and/or one or more lowered surface features based on the electrode and polymer thinning about an active area. Described below are several illustrative examples.

[**0096**] **FIG. 3A** shows a top elevated view of crossing common electrodes for a transducer **220** in accordance with a specific embodiment of the present invention. In this case, a set of horizontal top surface common electrodes **222** are linked together and disposed on the top surface of a transparent electroactive polymer **221**. In addition, a set of vertical bottom surface common electrodes **224** are linked together and disposed on the bottom surface of transparent electroactive polymer **221**. Top surface electrodes **222** may be activated commonly, as can bottom surface electrodes **224**.

[**0097**] **FIGS. 3B-3C** show top elevated photo of actuation patterns for a transducer **240** in accordance with another specific embodiment of the present invention. Transducer **240** includes a passive layer **242** disposed over a top surface of an electroactive polymer (not shown). The passive layer **242** enhances thickness changes in the polymer and visualization of surface features on the surface of passive layer **242**. In **FIG. 3B**, a voltage is not applied to the electroactive polymer and the surface of the passive layer **242** is essentially smooth and substantially flat. In **FIG. 3C**, voltage is applied to common electrodes and a set of depressed square surface features **246** are created. Also shown is a set of three depressed parallel line surface features **248** above the set of square surface features **246**.

[**0098**] Displacements may also be asymmetric across a passive layer. For instance, an electroactive polymer may include a plurality of active areas coated with a passive layer where the displacements may vary from one active area to another active area across the layer based on varying passive layer thicknesses for the different active areas.

[**0099**] In one embodiment, one or more electrodes are patterned or configured in surface area to affect a surface shape and appearance for a surface feature. **FIG. 3D** illustrates a top elevated view of a transducer **200** in accordance with a specific embodiment of the present invention (without a passive layer). Transducer **200** comprises electrodes **202***a-g* disposed on a top surface **204** of electroactive